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A CONSOLIDATION METER FOR MEASURING COMPACTION IN SALT WASTE BACKFILL

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Canadian Mine Technology Laboratory

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A CONSOLIDATION METER FOR MEASURING COMPACTION IN SALT WASTE BACKFILL

K. Judge* and G. Herget**

SUMMARY

A borehole consolidation monitor has recently been designed and constructed at the Canadian Mine Technology Laboratory (CMTL) to monitor consolidation in waste salt backfill. The monitor was designed to be installed in a downward vertical six inch diameter hole and provide a simple means of monitoring compaction due to traffic, continued backfilling and recrystallisation. The calibration constant is 1900 Ohm/mm.

Seven monitors have been built and installed at the Potash Company of America Potash mine, Sussex, New Brunswick. The monitors have performed very well in recording consolidation changes. Percentage consolidation changes agreed with independant measurements from vibrating wire consolidation meters and tillt meter records. The report describes the instrument and provides calibration information.

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Keywords: consolidation meter, backfill, potash

UN APPAREIL DE SURVEILLANCE POUR MESURER LA COMPACTION DANS LES REMBLAIS DE RÉSIDUS DE SEL

K. Judge * et G. Herget**

SOMMAIRE

Au Laboratoire canadien de la technologie minière, on a récemment conçu et fabriqué un instrument de surveillance de la consolidation en trous de sondage forés dans des remblais de résidus de sel. L'instrument a été spécialement conçu pour être inséré dans un trou vertical descendant de six pouces de diamètre. Il constitue un moyen simple de surveiller la compaction attribuable au trafic, au remblayage continu et à la recristallisation. La constante de calibrage est 1900 Ohm/mm.

Sept instruments ont été ainsi fabriqués et mis en place dans la mine de potasse de la Potasse d'Amérique à Sussex (N.-B.). L'enregistrement des changements de consolidation par les instruments en question a été très satisfaisant. Les changements enregistrés sont conformes aux mesures faites avec des appareils de mesure de la consolidation à câble vibrant et avec des clinomètres. Le présent rapport décrit l'instrument et présente des données sur le calibrage.

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Termes clés : consolidation, remblai, potasse

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1. INTRODUCTION

The Potash Company of America mine in Sussex/New Brunswick uses waste salt as an integral part of their cut and fill mining cycle. Waste salt is required to provide a mining floor in the stope and to provide support to the hanging wall.

To identify the consolidation which occurs after placement of the waste salt, a number of instrumentation systems were developed for the mine by the Canadian Mine Technology Laboratory of CANMET. One of the systems was a consolidation monitor with a 10cm stroke potentiometer. Mechanical details and assembly are described below.

2. DESIGN

Figure 1 shows a photograph of the consolidation monitor and Figure 2 shows an assembly drawing of the unit. The sensor is a 20K Ohm linear plunger type potentiometer with a nominal 10 cm (4 in.) travel. A parts list is given in table 1 with numbers corresponding to figure 2. More detailed information is given in figures 3 to 6.

The potentiometer is suspended from the collar of a vertical bore hole by a 20 cm (8 in.) diameter plywood disk. This disk is bolted on with a 5/8 in. coarse left hand threaded bolt, nut and two heavy washers. The plunger is connected to an extension sleeve and enclosed in a plunger sleeve.

The sleeves are made of nominal 3/4 in. and 1 in. copper water pipe. A special slider sleeve and O-ring seal were made (Figure 6) to resist water and other foreign material entering the potentiometer housing. A rubber grommet is used to pass the signal cable through the plunger sleeve and seal it. The bottom end of the extension sleeve is centred and held in the bore hole by a 12.5 cm (5 in.) diameter plywood disk which is then covered by backfill. This disk is pinned between two heavy washers using two hitch pins. These pins facilitate rapid assembly at the mine site.

For shipping the monitors are compressed to 1.5 m (5ft) with the plywood disks removed. The plywood disks have been finished with two coats of linseed oil and two coats of oil based paint to prevent delamination.

3. CALIBRATION AND FIELD PERFORMANCE

A calibration was carried out on the potentiometer with the nominal 10 cm stroke. The resistance change over 100mm is 1900 Ohm. The change of resistance with deformation is a straight line and the calibration factor is 190 Ohm per mm. (Figure 7)

Installation of the unit into a vertical hole in waste fill is straightforward and results are in good agreement with outputs from other systems. For the interested reader details of field installation and data analysis are given in reference 1.

4. CONCLUSION

A new low cost and rugged consolidation monitor has been developed with a resolution of about 1mm per 190 Ohm. Field installations have shown to be straightforward and percentage consolidations have been successfully determined in waste salt backfill.

5. REFERENCES

B.V. Roulston, R.J. Beddoes, G. Herget, 1990, Monitoring of consolidation of waste salt backfill, Proceedings on Stresses in Underground Structures, October 2 - 3, Ottawa/Canada.

Fig. 1 - Photograph of consolidation meter with 10cm potentiometer

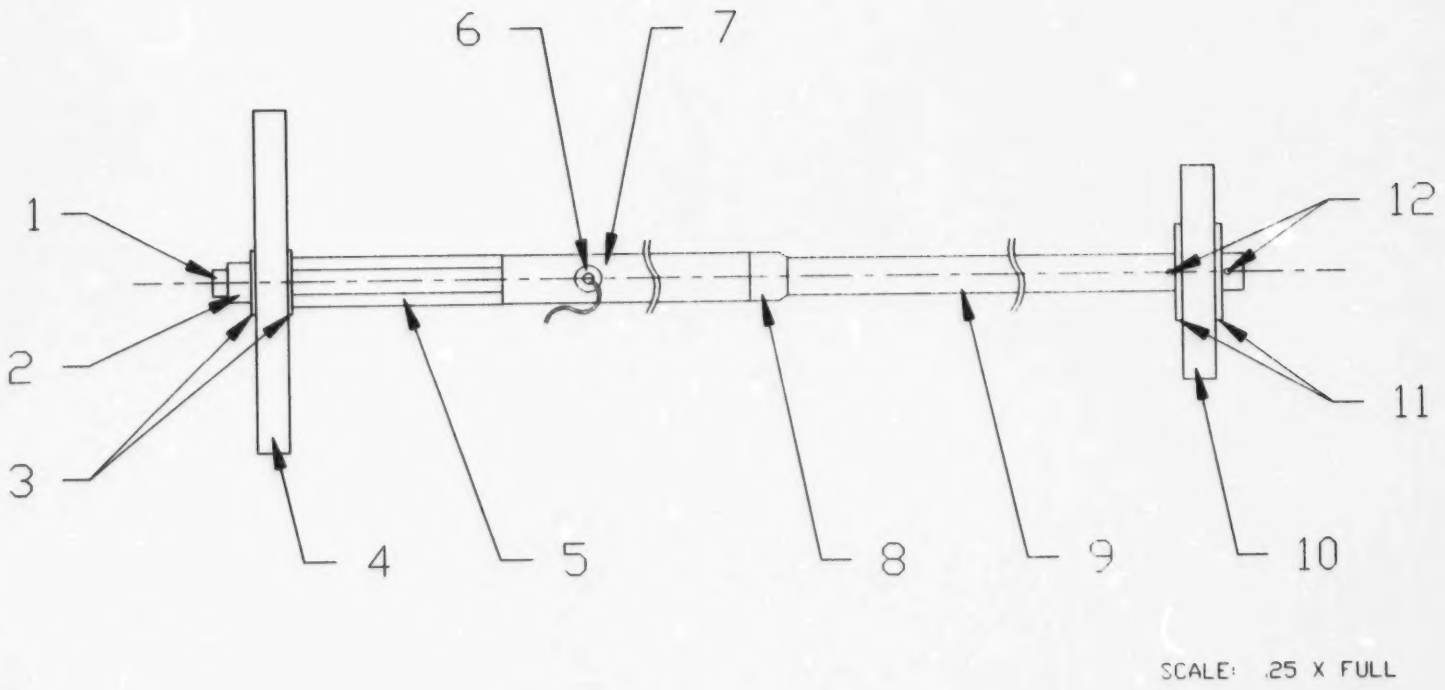

Fig. 2 - Ground movement monitor Model B-GM22 assembly drawing

(5) 4" LINEAR POTENTIOMETER
1 REQ'D

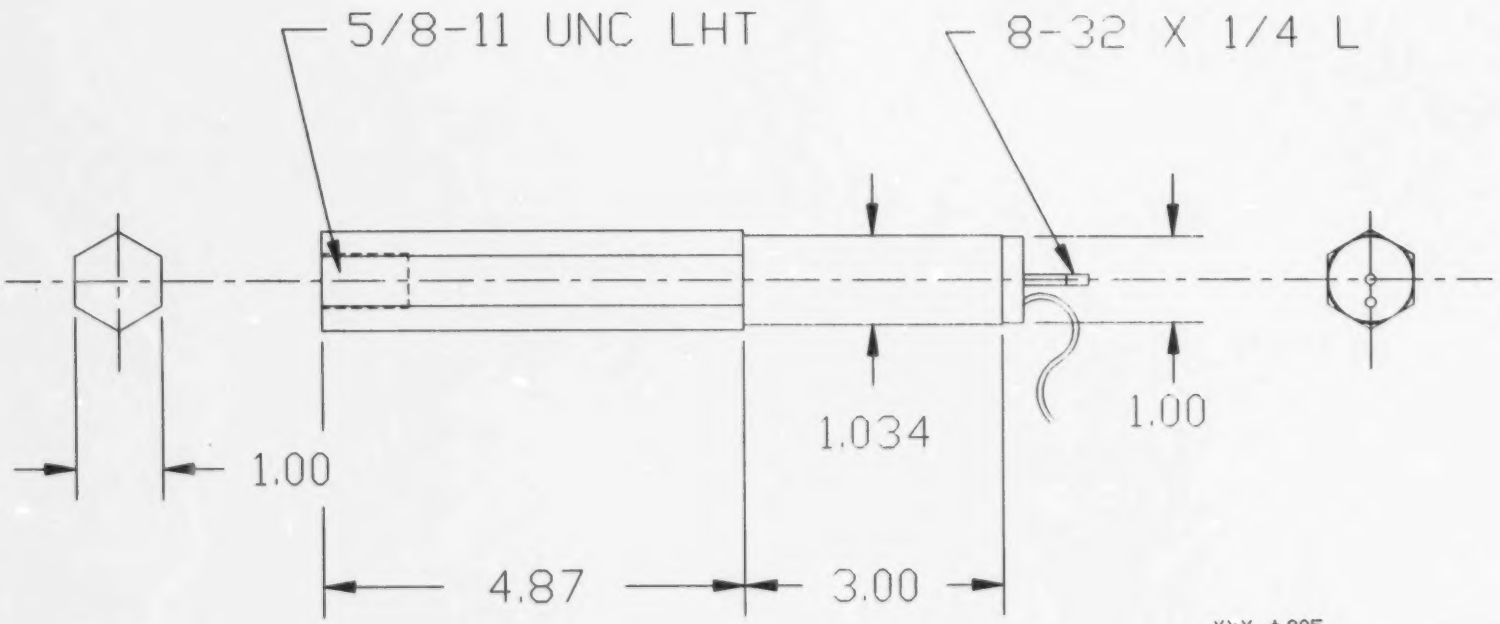

Fig. 3 - Potentiometer housing detail Model B-GM22

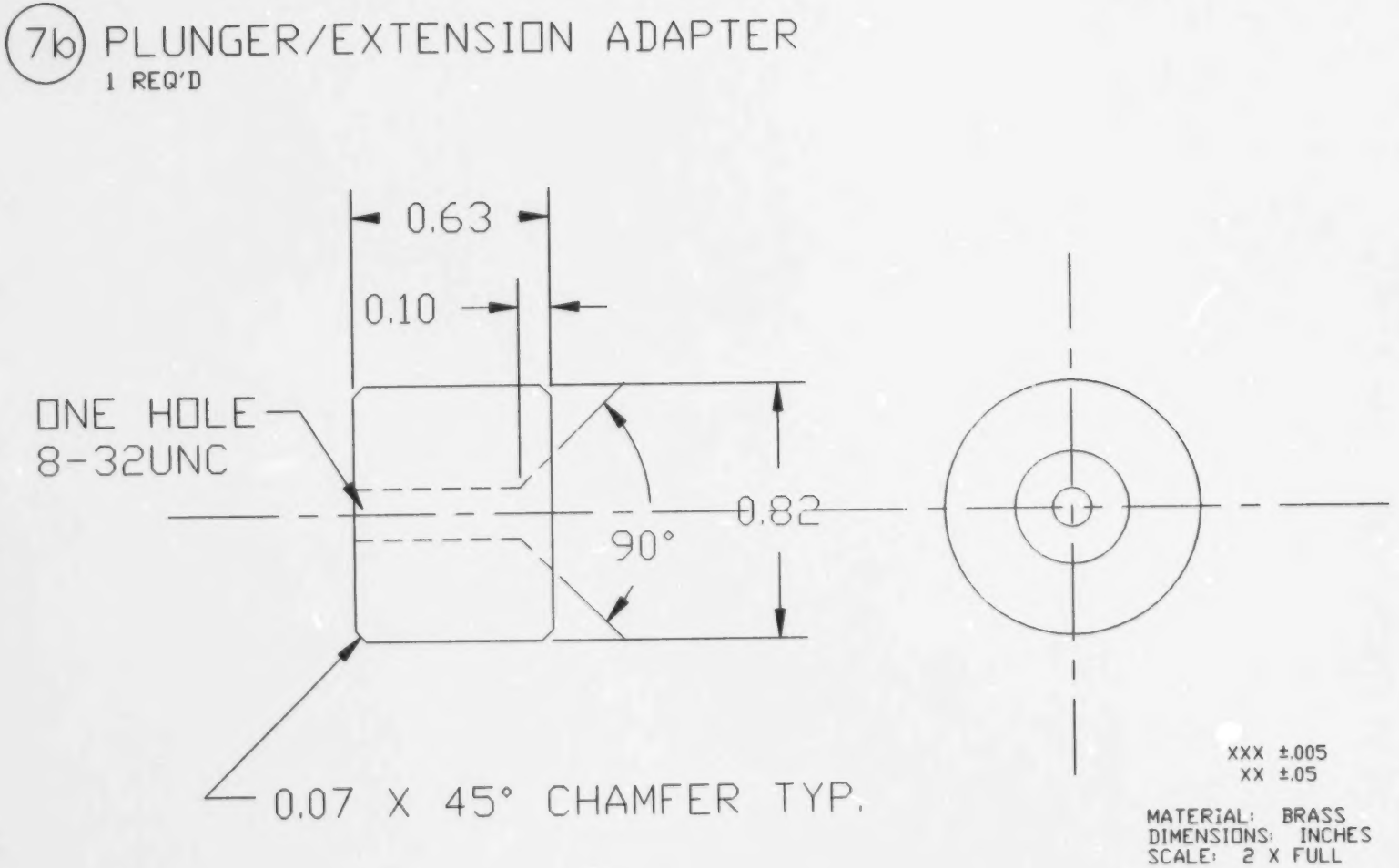

Fig. 4 - Plunger/extension adapter Model B-GM22

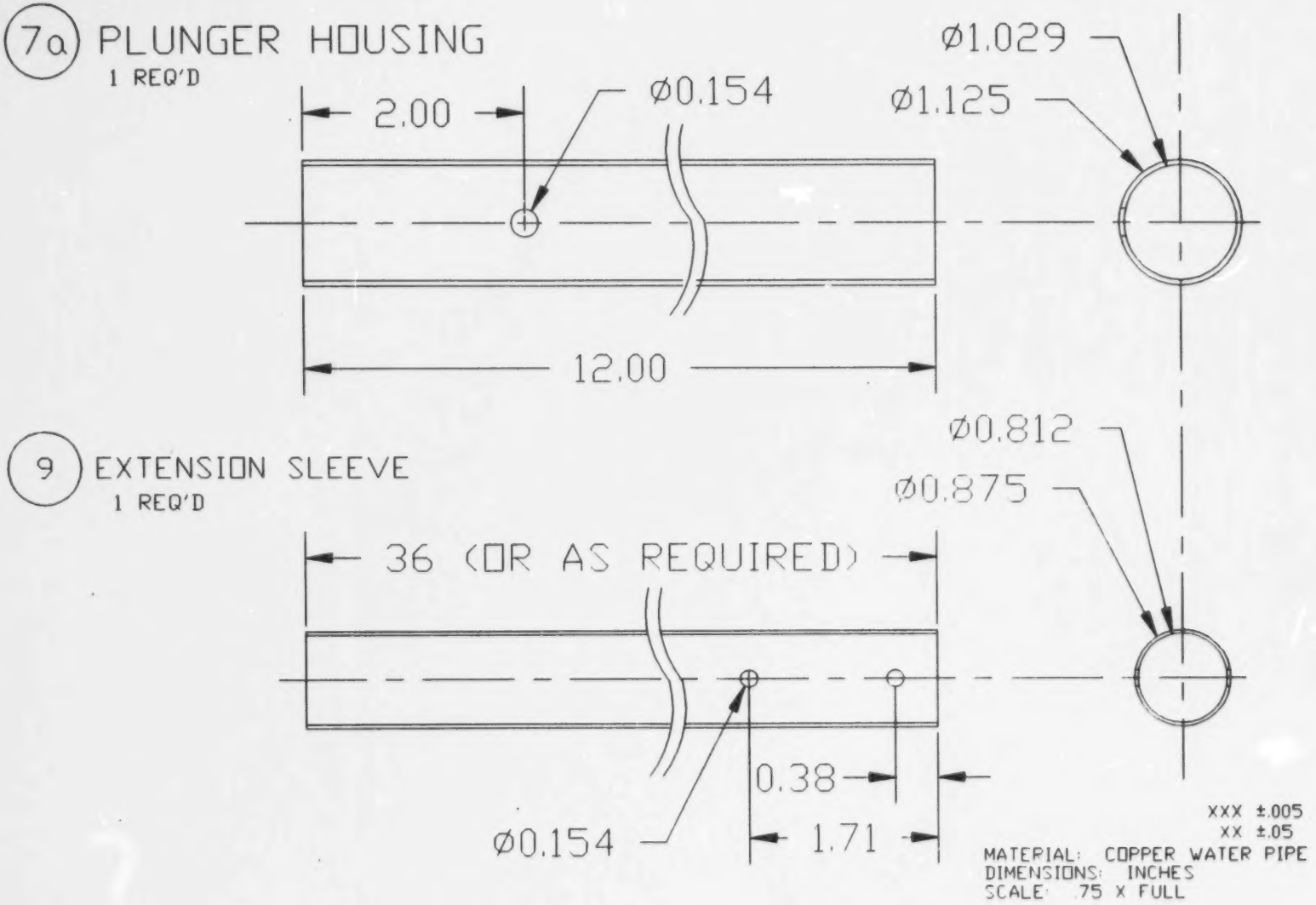

Fig. 5 - Plunger housing and extension sleeve detail Model B-GM22

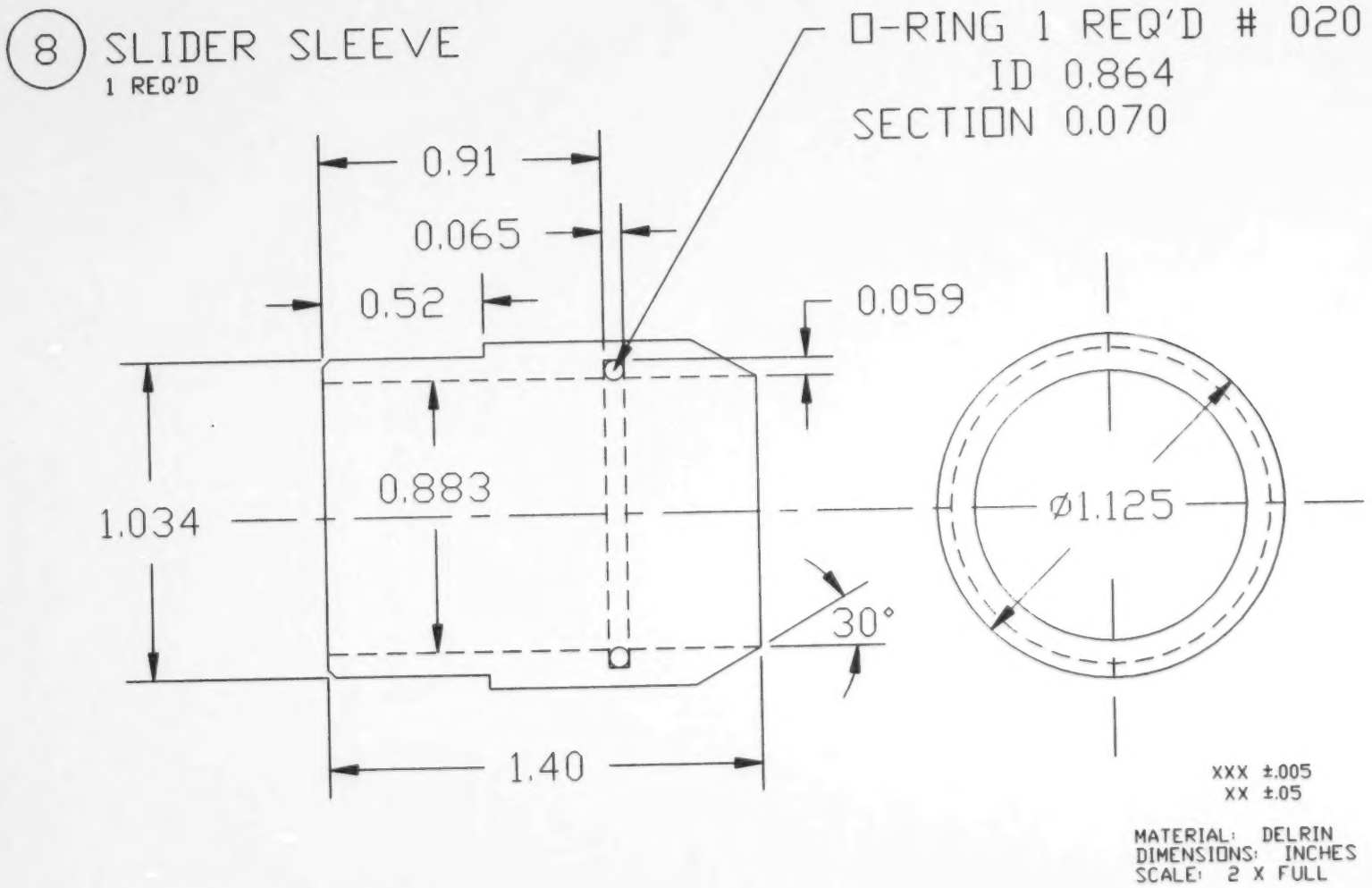

Fig. 6 - Slider sleeve detail Model B-GM22

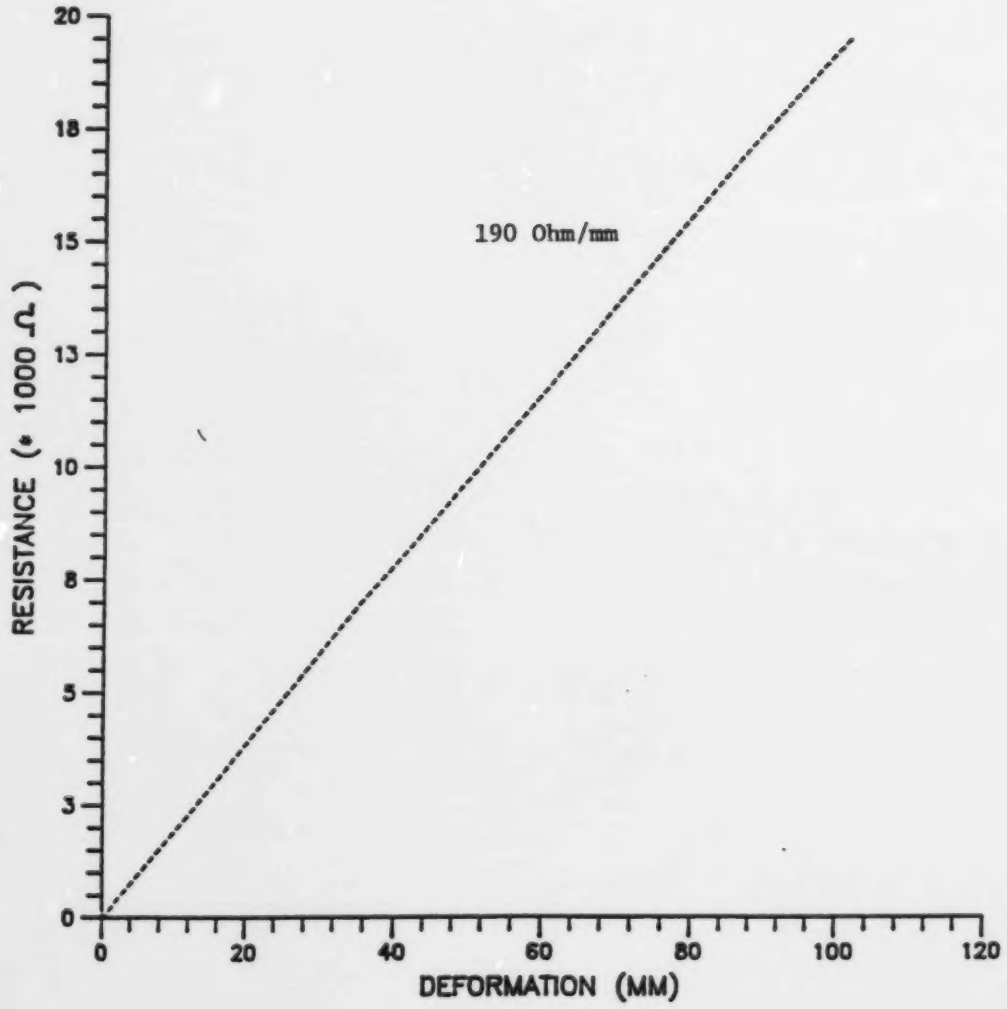

Fig. 7 - Calibration for the 4m (10cm) potentiometer

TABLE 1. Component of consolidation meter

1) 2 1/2" X 5/8" - 11 NC left hand threaded rod
2) 5/8" - 11 NC left hand threaded nut
3) 5/8" U.S.S. flat washer (2 required)
4) 8" O.D. X 5/8" I.D. X 3/4" G2S plywood (linseed oil & paint)
5) 20K Ohm linear potentiometer in 1" hex rod, 25 ft. cable
6) 1/4" O.D. (plus flange) X 3/16" I.D. rubber bushing
7) 12" X 1" dia. copper water pipe
   not shown: brass plunger / extension adapter
8) nylon sleeve and O-ring
9) 36" X 3/4" dia. copper water pipe
10) 5" O.D. X 7/8" I.D. 3/4" G2S plywood (linseed oil & paint)
11) 7/8" U.S.S. flat washer (2 required)
12) #9 hitch pin (2 required)

Note: Numbers correspond to numbers given in Figure 2.